DOCUMENT RESUME

ED 062 175 SE 013 638

TITLE	Authorized Course of Instruction for the Quinmester Program. Science: Introduction to Marine Science; Recreation and the Sea; Oceanography; Marine Ecology of South Florida, and Invertebrate Marine Biology.
INSTITUTION	Dade County Public Schools, Miami, Fla.
PUB DATE	71
NOTE	109p.
EDRS PRICE	MF-$0.65 HC-$6.58
DESCRIPTORS	Ecology; Instruction; *Marine Biology; *Objectives; *Oceanology; *Recreation; Secondary School Science; *Teaching Guides; Units of Study (Subject Fields)
IDENTIFIERS	Quinmester Program

ABSTRACT

All five units, developed for the Dade County Florida Quinmester Program, included in this collection concern some aspect of marine studies. Except for "Recreation and the Sea," intended to give students basic seamanship skills and experience of other marine recreation, all units are designed for students with a background in biology or chemistry. "Introduction to Marine Science" includes physical oceanography and local marine biology; "Invertebrate Marine Biology" concentrates on developing an understanding of diversity and evolutionary processes; "Marine Ecology of South Florida" examines energy and biomass relationships in marine ecosystems but also considers social, economic, and political implications; and "Oceanography" discusses the physics and chemistry of the ocean, including oceanic circulation. Each booklet lists performance objectives for the unit, lists any state-adopted texts, provides a synoptic summary of the course content, suggests activities and projects (in some cases original experiments, although most are citations of experimental descriptions in recommended texts), suggests topics for student projects or reports, indicates audiovisual materials available in the county and from other sources, and recommends reference books. Each booklet contains a chart relating each suggested activity to specific performance objectives. (Document is filmed from the best copy available.) (AL)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

INTRODUCTION TO MARINE SCIENCE

5369.02
5313.42
5312.42
5311.42

SCIENCE
(Experimental)

DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1971

SE 013 638

INTRODUCTION TO MARINE SCIENCE

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SCIENCE
(Experimental)

Written by J. Banta and J. Mayer, Jr.
for the
Division of Instruction
Dade County Public Schools
Miami, Fla.
1971

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Miami, Florida 33132

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INTRODUCTION TO MARINE SCIENCE

COURSE DESCRIPTION

An Introduction To Marine Science is a survey course relating to the student's environment as much as possible. Marine biology and oceanography will comprise the major part of this course. Local flora and fauna will be studied with laboratory work and field trips used to supplement their study.

The section on Physical Oceanography will include the study of sea water, ocean basins, waves and tides, and major ocean currents.

ENROLLMENT GUIDELINES

A student should have a sincere interest in the study of the oceans and the life therein. A "C" student with interest in marine science should be encouraged to enroll in this course. Valuable equipment and field trips are necessary parts of this course; therefore, we feel that students with significant behavioral problems should be discouraged from enrolling.

STATE ADOPTED TEXTS

There are no state adopted texts that can be used for this course as of this date. The teacher must select several references from those listed. Highly recommended for student use are references #9, #24, and #26. Teachers would do well to utilize references #8, #17, #21, and #28.

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The state publication listed here is excellent.

Florida State Department of Education. The Source Book of Marine Sciences. Tallahassee, Florida: State Department of Education, 1968.

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PERFORMANCE OBJECTIVES

1. Given various local marine plants and animals, the student will identify each by their common or scientific names.
2. Given a list of dangerous marine animals, the student will describe their effects upon humans.
3. Given the effect of dangerous marine animals on humans, the student will suggest the necessary first aid treatment.
4. The student will compare the life cycles of several marine animals.
5. The student will predict the results of altering one of the limiting factors on the sea's productivity.
6. The student will explain the causes of tides, currents, and waves.
7. The student will describe the sea water chemistry as it relates to maintaining a salt water aquarium.
8. The student will compare the topography of ocean basins to terrestial features.
9. The student will distinguish between effective recreational techniques and unproductive or hazardous activities.
10. The student will suggest reasons for the anticipated growth in the marine sciences.

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COURSE OUTLINE

I. Biological Science

A. Survey of local marine flora and fauna
1. Beaches and bays
a. Sandy beaches
(1) Adaptations of plants
a. Holophytes (e.g. sea oats, beach morning glory)
b. Algae (entromorpha and sargassum)
(2) Adaptations of animals
a. Burrowing (e.g., Emertia)
b. Camouflage (e.g., sand crab)
b. Rocky beaches
(1) Adaptations of plants
a. Hold fasts (Cauterpa)
b. Acetabularia
(2) Adaptations of animals
a. Attachments (barnacles and mussels)
b. Clinging under rocks
c. Mangroves
(1) Importance in terms of breeding grounds
(2) Typical plants and animals (Arotus, Littorina)
d. Sandy bays
(1) Plants of the bay (Thallasia, Diplanthera)
(2) Animals of the bay (invertebrates and fish)
e. Muddy bays
(1) Plants (Diplanthera)
(2) Animals (heart urchin, Chaetopterus)
2. Coral reefs
a. Building corals (Acropora and Montastrea)
b. Invertebrates (Diadema and gorgonians)
c. Vertebrates (Holcanthus-queen angel, Abudefdef-sergeant major, Eupomacentrus-beau gregory, Thalassoma-blue wrasse)
3. The open sea
a. Plankton
(1) Phytoplankton
(2) Zooplankton
b. Pelagic animals
(1) Invertebrates
(2) Vertebrates

B. Dangerous sea creatures
1. Venomous-Physalia, hydrozoans, cones, stone fish, toad, sting rays, sea snakes
2. Spiny-urchins, catfish and dogfish
3. Miscellaneous-electric skate, sharks

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C. Porpoise, killer whale, giant squid, deep water fishes, ribbon worms
D. Harvesting the sea
   1. Primitive methods-spears, poisonous hooks and traps
   2. Modern methods
      a. Types of nets and netting
      b. Traps and long lines
   3. Methods of the future
      a. Farming
      b. Electrical attraction and suction

II. Physical Oceanography

A. Tides
   1. Causes of tides
      a. Gravitational effects
      b. Topographical features
      c. Resonance effect
   2. Types of Tides-diurnal, semi-diurnal and mixed, spring and neap
B. Water movement
   1. Currents
      a. Wind driven
      b. Density currents
         (1) Temperature
         (2) Salinity
         (3) Turbidity
      c. Coriolis force
   2. Oceanic circulation-example Gulf Stream
C. Waves
   1. Structure of waves-use terms: crest, trough, and length
   2. Generation of energy
   3. Factors affecting wave height in open seas
      a. Wind speed
      b. Fetch
      c. Duration of the wind
D. Chemistry of sea water
   1. Dissolved gases, CO_2 and O_2
   2. Dissolved salts
E. Ocean basins
   1. Continental drift theory
   2. Mid ocean ridges
   3. Other features-guyots, sea mounts
   4. Reef distribution

III. Marine Recreation

A. Fishing techniques
   1. Licenses
   2. Seasons
   3. Baits and lures

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B. Boating regulations
   1. Rules of the road
   2. Safety regulations
      a. Soft ware
      b. Hard ware
C. Swimming and diving
   1. Regulations
   2. Safety rules
   3. Equipment
D. Other water sports, surfing, water skiing

IV. Your Future In the Marine Sciences

A. Technologists
   1. Schools
   2. Types of jobs
B. Scientists
   1. Schools and schooling
   2. Types of jobs

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EXPERIMENTS

Rabinowitz, Sutton & Taylor. Oceanography: An Environmental Approach to Marine Science. Paterson, New Jersey: Oceanography Unlimited Inc., 1970.

1. Salt Water Aquaria for the Laboratory and Classroom (p. 12)
2. Collecting and Preserving Marine Organisms (p. 17)
3. Plankton (p.40)
4. Dangerous Sea Life (p. 97)
5. Physical Oceanography and Physiography (p. 121)
6. Using the 24-Hour Clock (p. 135)
7. Ocean Waters in Motion (p. 137)
8. Beach Analysis (p. 157)
9. Basic Chemistry for Oceanography (p. 162)
10. Basic Physics for Oceanography (p. 170)
11. Biological Properties of Light in Ocean Water (p. 172)
12. Basic Oceanographic Instruments (p. 179)

Florida State Department of Education. The Source Book of Marine Sciences. Tallahassee, Florida: State Department of Education, 1968.

13. Salt-Water Aquaria for the Laboratory-Classroom (p. 1)
14. Using the 24-Hour Clock (p. 9)
15. The General Nature of Tides (p. 11)
16. Charting Local Current Systems (p. 15)
17. Beach Analysis (p. 23)
18. pH Determination of Sea Water (p. 35)
19. The Determination of the Salinity of Sea Water: Titration Method (p. 43)
20. The Taxonomy of Marine Animals (p. 57)
21. Plankton (p. 63)
22. Light: The Importance of the Study of the Physical and Biological Properties of Light in Ocean Water (p. 135)

U.S. Naval Oceanographic Office. Teacher's Ocean Science Study Kit. Washington, D.C.: U.S. Naval Oceanographic Office, 1966.

23. Drawing a Tide Curve (exercise 1)
24. Mapping of Bottom Materials (exercise 2)
25. Bathymetric Analysis (exercise 3)

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PROJECTS

1. Map a section of the school campus. Locate seven stations. A station may be a tree, a pond, or other point of interest. Draw the map to scale.
2. Collect specimens from a beach. Use the transect method and classify at least five specimens from your collection. (Collecting permits for teachers may be obtained by writing to: Department of Natural Resources Larson Building, Tallahassee, Florida 32304
3. Collect local algae samples and mount them on herberium paper. Identify the algae and mount representative samples of the five major phyla.
4. Set up and maintain a marine aquarium for at least six weeks. Local fish and invertebrates such as echinoderms, mollusks, and arthropods should be included.
5. Using a seine net, make a collection of the fauna from a local beach area. Identify ten of the specimens that you collect.
6. Make a synopsis report on at least three plants or animals.
7. Collect and make a "stomach analysis" of at least two different animals. Try to establish the food chain involved in your specific animals.

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REPORTS

1. Discuss the problems of planktonic life. Include pressure, temperature, defense mechanisms, and overpopulation.
2. What first aid precautions and procedures would you suggest in the event one of your swimming companions is stung by anemones or suffer coral cuts?
3. What distinguishing physical characteristics separates the phylum Cnideria from the phylum Cternophora?
5. Trace the life cycle of four flukes that infest mankind, namely, blood flukes, lung and liver flukes, intestinal flukes.

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FIELD TRIPS

1. Bear Cut
   Key Biscayne

2. Crandon Park
   Crandon Blvd.
   Key Biscayne

3. Department of Interior
   Bureau of Commercial Fisheries
   Tropical Atlantic Biological Laboratories
   75 Virginia Beach Drive
   Virginia Key

4. Matheson Hammock
   Old Cutler Road
   Coral Gables

5. Museum of Science
   3280 South Miami Ave.

6. Seaquarium
   Rickenbacker Causeway
   Virginia Key

7. University of Miami
   Rosenstiel School of Marine and Atmospheric Sciences
   Virginia Key

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GUEST SPEAKERS

1. Dr. Jesse White (Veterinarian)
   Seaquarium

2. Rosenstiel Institute of Marine and Atmospheric
   Science
   Key Biscayne

3. Museum of Science
   3280 S. Miami Ave.
   Florida Marine Aquarium Society

4. Tropical Atlantic Biological Laboratories
   Virginia Key

5. Underwater Unlimited
   Coral Gables
   (supply speaker on diving)

6. Local Power Squadron
   contact U.S. Coast Guard

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DADE COUNTY 16MM FILMS

	Title	Producer	Time	Number
1.	Animal Life At Low Tide	Dowling	11	1-02696
2.	Animals That Live In the Surf	Sigma	11	1-02699
3.	Beach and Sea Animals	EBEC	11	1-02664
4.	Between the Tides	Contemporary	20	1-11071
5.	Coral Wonderland	Ausrtal	30	1-30697
6.	Exploring the Ocean	Church	11	1-02069
7.	Fish, Moon, and Tides The Grunion Story	Academy	15	1-11177
8.	Gulf of Mexico Invertebrates	Rutgers	15	1-02704
9.	Marine Animals of the Open Coast	Moyer	22	1-11075
10.	Marvels in Miniature	Austral	15	1-11143
11.	Mollusks	EBEC	14	1-11149
12.	Secrets of the Undersea World	Disney	16	1-11144
13.	Shellfishing (old film)	EBEC	14	1-03930
14.	Some Creatures of the Barrier Reef	Austral	10	1-02686
15.	Tigers Of the Sea	Lewis	10	1-03928
16.	We Explore the Beach	Coronet	10	1-02205
17.	Whales and Whalerman	Hoefler	22	1-11522
18.	Mysteries of the Deep	Disney	28	1-31432
19.	The Sea	EBEC	27	1-31381
20.	Ocean Currents	McGraw	17	1-13128
21.	Tides of Fundy	Canadian	15	1-11275
22.	Anyone for Diving?	L.A. Co.	30	1-30859

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FILM LOOPS

The following Marine Biology Series film loops can be obtained from Encyclopedia Britannica:

1. Abalone
2. Barnacle (acorn)
3. Basket Star
4. Clam (defense reaction)
5. Feather Star
6. Hermit Crab
7. Marine Clam
8. Marine Snail
9. Razor Clam
10. Relatives of the Sea Star
11. Sand Dollar
12. Sandy Ocean Shore
13. Sea Anemone
14. Sea Cucumber
15. Sea Urchin
16. Serpent Star
17. Scallop
18. Squid
19. Squid (color changes)
20. Tube Worms

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TRANSPARENCIES

The following transparencies can be obtained from the Dade County Multimedia Center. Two hundred cells will be made free of charge and sent to the school that requests them.

Transparency #	Title	# Cells
G22	Continental and Ocean Crusts	5
F35	How Physical and Chemical Loads Are Carried In a Stream	5
G42	Evolution of a Sand Dune	5
G43	Some Types of Dunes	5
I52	Wave Refraction	1
I53	Seaward Growth of a Delta	5
I54	Coastal Erosion and Deposition	5
I55	Coral Reef Forms	5
K58	Submarine Relief	5
L80	Floor of the Atlantic	3
L81	Spreading Floor of the Atlantic Ocean	1
L82	Major Surface Currents of Oceans	1
L83	Deep Water Circulation of Atlantic Ocean	1
L84	Distribution of Sediments on the Ocean	1
L85	Life Zones of the Sea	1
M94	Tides	1

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FILMSTRIPS

1. Life #207 Creatures of the Sea
2. Life #208 Coral Reef
3. Life #202 Miracle of the Sea
4. Life #216 Mighty Currents of the Sea
5. Life #217 Landscapes of the Sea
6. Life #313 Sharks
7. Life #314 Sharks

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DISCUSSION QUESTIONS

1. Discuss the advantages of using scientific nomenclature instead of the common names of plants and animals.
2. Which mollusks are most dangerous in the Florida area?
3. What are the treatments for the various forms of stinging type accidents?
4. Discuss the life cycle of two of the following: Flukes that infest man, such as, liver fluke, lung and blood fluke, or the pink shrimp, the blue claw crab, or the fiddler crab.
5. If pollution kills off many of the phytoplankton, what would be the results of such carelessness to the entire food chain in the sea?
6. What are the most important factors that cause and regulate our tides, waves, and major ocean currents?
7. What are the critical factors involved in maintaining a salt water aquarium? How do these factors affect the lives of the marine organisms?
8. Compare terrestrial topography to that of the ocean basins. Include types of features, sizes, shapes, heights, depths, and the probable causes for the development of the various features.
9. Contrast safe with hazardous techniques while engaging in the following activities: swimming, boating, surfing, skin and scuba diving, fishing, and water skiing.

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10. If the current trends in population and pollution continue, what will be the major challenges of the marine scientist to help reverse the above trends?

11. Some people claim that for survival we must turn to the sea for food supply and more "living space". Develop both pro and con answers to the above statement.

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REFERENCES

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2. Axlerod, H.R. and Vorderwinkler, W. Salt Water Aquarium Fish. Jersey City, New Jersey: T.F.H. publications, Inc., 1965.

3. Barnes, H. Oceanography and Marine Biology - A Book of Techniques. New York: The MacMillan Co., 1959.

4. Bascom, W. Waves and Beaches: The Dynamics of the Ocean Surface. Garden City, New York: Anchor Books, 1964.

5. Carleton, R. The Underwater Guide to Marine Life. New York: A.S. Barnes and Co., 1965.

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24. Stephens, W.M. Southern Seashores. New York: Holiday House, 1968.

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26. U.S. Naval Oceanographic Office. Science and the Sea. Washington, D.C.: U.S. Naval Oceanographic Office, 1967.

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MASTER SHEET - INTRODUCTION TO MARINE SCIENCE

Objectives	Experiments	Student Text	Supplementary References	Films	Film Loops	Transparencies	Film Strips
1	2, 20	24 pp.25-34	12, 5	1, 2, 3, 4, 5, 8	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18		1
2	4	26 pp.25-34	14	15			6, 7
3	4	26 pp.25-34	14	15			6, 7
4	3, 20, 21	24		7, 8, 9, 10, 11, 14	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20		2
5	9, 11, 22	9 Chap. 6		13, 17			3
6	10, 14, 15, 16, 23	9 Chap. 9, 10, 11	4	20, 21		I 52 L 82 L 83 M 94	4
7	1, 9, 13, 18, 19	9 Chap. 6		19		F 35	
8	5, 8, 12, 17, 24, 25	9 Chap. 5, 8		6, 12, 16,18	12	C 22 I 54 K 58 L 80 L 81 L 84	5
9			8	22			
10		9 Chap. 4	27	6, 16			

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

RECREATION AND THE SEA

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SCIENCE

DADE COUNTY PUBLIC SCHOOLS

DIVISION OF INSTRUCTION • 1971

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RECREATION AND THE SEA

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SCIENCE

Written by Burt Bond and William Raymond
for the
DIVISION OF INSTRUCTION
Dade County Public Schools
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RECREATION AND THE SEA

COURSE DESCRIPTION

This course will include basic seamanship techniques, equipment maintenance, and safety. Recreations, such as fishing, snorkeling, and underwater photography will be explored.

ENROLLMENT GUIDELINES

None.

STATE ADOPTED AND PREVIOUSLY STATE ADOPTED TEXTS

1. Bisque, et.al. Investigating the Earth. Boston: Houghton Mifflin Co., 1967.

2. Metcalf, Williams, Castka. Modern Chemistry. New York: Holt, Rinehart & Winston, 1966.

3. Namowitz and Stone. Earth Science the World We Live In. Princeton, New Jersey: D. Van Nostrand Co., Inc., 1967.

SUGGESTED STUDENT TEXT

1. Fin. Coral Gables, Florida: Fin Publishing Co., Inc., 1971.

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PERFORMANCE OBJECTIVES

The student will:

1. Differentiate among various hull constructions, boat-building materials, and classes and types of motorboats.

2. Cite problems in purchasing, maintaining, and handling trailers and motors.

3. Use common nautical terms.

4. Describe methods and techniques of maneuvering a motorboat.

5. Explain line composition and use various lines to tie appropriate knots.

6. Define terms used in marlinspike seamanship.

7. Identify aids to navigation in local waters.

8. Demonstrate skills needed to pilot a motorboat, such as plotting a course, computing compass and true courses, obtaining bearings, and taking fixes.

9. Cite inland rules of the road for lateral bouyage and the intercoastal waterway.

10. Cite the legal responsibilities in motorboating.

11. Contrast safe and unsafe practices in motorboating.

12. Identify local sport and food fish.

13. Be able to choose fishing equipment, time, conditions and location which are appropriate to the type of fish he wishes to catch.

14. Be able to rig his line for bottom fishing, trolling, and casting.

15. Be able to demonstrate the proper landing and handling of fish by using various fishing gear according to specification.

16. Be able to clean and prepare a fish for cooking.

17. Properly care for and maintain fishing equipment according to specification.

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18. Describe the location and inhabitants of:

    a. Fresh water recreation areas
    b. Canals and Miami River
    c. Biscayne Bay
    d. Reefs
    e. Gulfstream

19. Collect, classify and preserve animals and plants from each location.

20. Manipulate the parts of a simple underwater camera.

21. Solve common problems encountered in underwater photography including depth, photoextinction, camera bouyancy and housing defects.

22. Take photographs using a simple camera underwater.

COURSE OUTLINE

I. Basic Seamanship (16)*

   A. Small Boating

      1. Hull construction methods
      2. Building materials for boats
      3. Motorboat classes and Motorboat Act of 1940
      4. Trailers and their handling
      5. Nautical terms and definitions
      6. Motor matching to boats
      7. Sailing vessel types and terms

   B. Maneuvering Methods

      1. Propellors (screws)
      2. Rudder and screw effect
      3. Handling
      4. Mooring
      5. Ground tackle
      6. Heavy weather handling
      7. Outboard steering

---

* Numbers following each major division represent suggested total class periods for adequate coverage.

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C. Marlinspike Seamanship and Line Handling

1. Line composition and designation
2. Terms
3. Knots
4. Splices
5. Whipping
6. Care of Line

D. Navigational Aids

1. Responsibility of installation and maintenance
2. Lighthouses and lightstations
3. Lateral bouyage system
4. Intercoastal waterway aids
5. Private aids to navigation
6. Marking of wrecks
7. Electronic aids
8. Publications

E. Charts and Compass Corrections

1. Nautical chart orientation
2. Course error computation
3. Laying out a course
4. Bearings
5. Position fix
6. Plotting and piloting tools
7. Charts and publications

F. Rules of the Road

1. Geographical limits of rules
2. Source of rules
3. Matters covered by the rules
4. Traffic situations
5. Lights
6. Sound signals for vessels
7. Fog rules
8. General Prudential rule
9. State and local rules
10. Whistle signals
11. Sailing vessel rules

G. Legal Responsibilities of Boaters

1. Motorboat regulations for vessels
2. Coast Guard approved equipment and classes of requirements
3. Safety equipment
4. Fire extinguishers and use
5. Legal equipment requirements
6. Additional equipment

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7. Boatman's responsibilities
8. Accidents and boating
9. Sales or transfers and sales to aliens
10. Regulatory programs and activities

H. Safe Motorboat Operation

1. Loading vessels
2. Marine engines
3. Lubrication
4. Fueling dangers
5. Performance characteristics
6. Engine trouble shooting
7. Weather reports
8. Large vessel dangers
9. Distress signals and communication procedures
10. Marine communication and visual signals
11. Boating courtesy and practical hints for safe boating

II. "Scientific" Fishing (10)

A. Types of fish

1. Sport
2. Food

B. Types of Equipment

1. Spinning
2. Casting
3. Fly

C. Time for Fishing

1. Tides
2. Seasons
3. Time of day
4. Weather

D. Location

1. Area to be fished
2. Positioning of boat

E. Lures and rigs

F. Landing and handling

G. Cleaning and preparing fish

H. Care and maintenance

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III. Local Waters and Their Inhabitants (11)

A. Fresh water recreation areas

B. Canals and Miami River

C. Biscayne Bay

D. Reefs

E. Gulfstream

IV. Elementary and Underwater Photography (5)

A. Camera

1. Parts
2. Function

B. Film

1. Preparation or manufacture
2. Function

C. Light and Light Meters

1. Spectrum
2. Differential photoextinction underwater

D. Camera Housings

1. Sealing, corrosion, hydrostatic balance
2. Materials--plastic, metal, rubber

E. Cameras

1. Simple types
2. 35 mm.
3. Movie cameras

F. Viewfinders and Light Meters

G. Daylight

1. Penetration or photoextinction
2. Color film

H. Artificial light

1. Flash bulbs
2. Strobe

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V. Underwater Sound Recording (2)

A. Hydrophone Construction

1. Microphone waterproofing

a. Vinyl tape
b. Plastic--"baggies"

2. Weights--sinkers to overcome bouyancy
3. Hydrophone wire - at least 35 feet

a. Cleaning and soldering
b. Insulation

B. Selection of portable tape recorder

1. Portability
2. Salt air corrosion

C. Recording Techniques

1. Monitoring methods
2. Hydrophone placement in field
3. Elimination of accoustical artifacts
4. Construction and use of a parabolic reflector

VI. Snorkeling (1)

A. Snorkel types and safety
B. Swim fin types and safety
C. Snorkeling methods and practice

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EXPERIMENTS

1. Compare, by means of a suitable spring balance, the holding power of a long vs. a short splice of identical rope.

2. Compare, by means of a suitable spring balance, the holding power of various knots in fishing line.

3. A variation of the above is to fasten ropes or fishing lines consisting of both long and short splices to an immovable stanchion and pull to see which unravels first. Another variation is to do the same with the various knots.

4. Night running light recognition may be simulated using wooden sticks and colored lights arranged as Intracoastal Waterway and International light configurations. This provides a means of testing the individual's responses in determining the right of way, crossing, passing, and head-on situations of craft of various classes.

5. An experiment which uses compasses, road maps or navigational charts and inexpensive tranistor radios can show students how to obtain a radio "fix". The map first must be north oriented by means of the compass. The ferrite antenna rods of these radios has a null point (radio goes dead) when pointing at the source of radiation (the transmitting antenna). The intersection of four or five station position lines on the map or chart indicates the student's location.

6. An experiment in elementary cartography can be designed using army compasses to obtain bearings and establishing a base line of known length on the school campus or in the field.

7. Expose color film at various depths underwater to determine differential photoextinction levels for different film brands and sensitivities.

8. Using a hydrophone, devise a method to determine the rule for underwater sound intensities.

9. Check stomachs of fish to determine feeding habits.

10. Dissect and compare anatomy of various species of fish.

11. Compare corrosive effects of salt water on different types of metals, some of which have been protected by various methods.

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DEMONSTRATIONS

1. Determine the relative crushing strengths of various hull materials (aluminum, fiberglass, wood) by means of an inverted U-shaped structure, a hydraulic jack, and a pressure meter.

2. In a large tank or child's swimming pool, tilt the motor of an outboard model boat back and forth on the transom to show how boat will porpoise or pitch-pole.

3. Show how a course is plotted on a chart. Use dividers and parallel rules.

4. Using a compass, show how to find bearings and "hidden treasure" in the classroom.

5. Start a "treasure hunt" laid out by students for other students. Use base lines and compass bearings from maps of the campus to pinpoint locations of treasures.

6. Make a model outboard motor with parts painted various colors for easy identification to show how the different parts work together to propel the vessel.

7. Using an old camera paint the parts various colors for easy identification to show how the parts operate to produce a picture.

8. Show students various slides taken under different artificial and natural lighting conditions to illustrate the effects of lighting on picture quality.

9. Have students listen to tapes, made by hydrophones, of motors, waves on seawalls and other artifacts so that they may distinguish these "errors" from sounds made by sea animals.

10. Listen to marine communications on short wave radio.

11. Have students bring in rods, reels, and lures to demonstrate.

12. Demonstrate proper methods of casting.

13. Demonstrate the proper method of cleaning fish.

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PROJECTS

1. Build a collection of boat models that show various hull styles and materials used throughout history.

2. Show how the galvanized metals used on trailers resist corrosion better than the same base metal of the same gauge and size in identical salt water.

3. Build a model boat and label parts with nautical terms.

4. Make a knot board.

5. Build model lighthouses with the characteristics of actual ones in operation in our area.

6. Make models of Intracoastal Waterway navigational aids.

7. Lay courses for various local fishing grounds on local charts.

8. Make working, actual size replicas of historic navigational instuments, such as compass boxes and cross-staffs.

9. Collect or duplicate copies of ancient charts of the Caribbean.

10. Record sound signals used by boat traffic on tapes.

11. Photograph flora and fauna of local reefs.

12. Take aerial photographs of a field trip survey area by means of working model rockets having cameras. Then make accurate maps of the area. (similar to Estes "Camroc" toy rocket).

13. Collect underwater sounds of both natural and man-made types in local areas.

14. Make displays of hooks, rigs, lures, etc.

15. Make charts showing the best times and places to fish for certain species of fish.

16. Collect, preserve and mount inhabitants of an aquatic community.

17. Build a saltwater aquarium.

18. Make posters of different types of fish.

19. Make charts of popular fishing sites.

20. Make cardboard box diorama of local reefs.

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21. Tie lines to lures and hooks (clinch knots, barrel knot, etc.)

22. Rig lines with fresh bait for trolling, casting, and bottom fishing.

23. Clean and prepare a fish for cooking.

24. Collect specimens from each aquatic community studied.

25. Preserve specimens.

26. Maintain live specimens in an aquarium.

REPORTS

1. History of ships and shipbuilding.
2. Derivation of nautical terms.
3. Dictionary of common nautical terms.
4. Unsafe boating practices.
5. History of navigational aids in the United States.
6. Knots commonly used by other cultures.
7. Illumination power and range of various lighthouses.
8. History of older lighthouses in the United States and elsewhere.
9. Famous wrecks, their positions, and historical accounts of their demise.
10. History of navigational instruments.
11. Origin of the Rules of the Road.
12. A collection of state and local boating rules.
13. U.S. Coast Guard statistics on boating accidents centered on most common times, dates, and circumstances.
14. Specifications on the latest types of inboards and outboards available to the public. (Information may be obtained by writing to the engine manufacturers.)
15. History and/or methods of underwater photography.
16. Types of boats and hulls available to the public.
17. The history and/or methods of underwater sound recording.
18. Inhabitants of an aquatic community.
19. Different methods of fishing.
20. Bait.
21. The best time and location to fish for certain species.
22. Commercial fishing.
23. Care and maintenance of fishing equipment.
24. How pollution affects each aquatic community.
25. Factors which affect fishing.
26. Artificial lures.
27. How to find fish.
28. Fishing laws of this area.
29. Local fish catches.
30. The history of fishing.

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FIELD TRIPS

1. Miami Seaquarium, Rickenbacker Causeway
2. Rosenthiel School of Marine and Atmospheric Sciences, Rickenbacker Causeway
3. Coast Guard Station, MacArthur Causeway
4. Commercial Fishing Companies
5. Boat Building Companies
6. Fishing Piers
7. Drift Boat Tours
8. Glassbottom Boat Tours
9. Parks: Haulover Park (beach, jetties, pier)
   Crandon Park (seashore, tidal pools)
   Matheson Hammock (mangrove shore)
   Everglades National Park (fresh water ponds)
   John Pennekamp State Park (reefs)
   Elliot Key Park (lower Biscayne Bay)
   State recreation areas (freshwater fishing)
10. Fishing bridges (Bear Cut)
11. Aquatic sites of interest under study
12. Boat trailer manufacturer
13. Local marine hardware manufacturer
14. Visit large vessels (navigational plotting center)

SPEAKERS

1. Contact U.S. Coast Guard Auxiliary, listed in white pages, and ask for the phone number of the Division Public Education Officer to arrange for speakers on boating subjects.

2. Contact nearby dive shops to obtain speakers on snorkeling.

3. Contact local camera shops to obtain speakers on underwater cameras.

4. Contact local fishing gear suppliers for speakers on equipment.

5. Contact fishing tournament sponsors and associations for speakers.

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RELATED PROBLEMS

1. Compute pitch of props with blades at various angles.
2. Compute or graph relation of diameter of lines to tensile strength.
3. Use inverse square formula for light and sound intensities.
4. Prepare maps from base lines and bearings.
5. Compute course errors from compass to true, and vice-versa.
6. Demonstrate how angles and similar triangles can determine a position fix.
7. Compute engine displacements.
8. Show how Archimedes Principle can determine weights of vessels.
9. Show how to compute capacities of various shaped fuel tanks.
10. Show how to compute f-stops in cameras.
11. Contrast length and girth of fish to their weight.
12. Determine pressure vs. depth relationships in sea water for divers.

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DADE COUNTY 16MM FILMS

1. Beach and Sea Animals
   AV# 1-02664, 11 minutes, BW

2. Between the Tides
   AV# 1-11071, 20 minutes, C

3. Gulf of Mexico Invertebrates
   AV# 1-02704, 15 minutes, C

4. Life in an Aquarium
   AV# 1-02671, 10 minutes, BW

5. Life in the Ocean
   AV# 1-11043, 18 minutes, C

6. Marine Animals of the Open Coast
   AV# 1-11075, 22 minutes, C

7. The Mollusks
   AV# 1-11149, 14 minutes, BW

8. Pond Life
   AV# 1-02726, 10 minutes, BW

9. Reproduction in the Sea Urchin
   AV# 1-11055, 13 minutes, C

10. Sea Shell Animals
    AV# 1-02682, 10 minutes, C

11. Sunfish
    AV# 1-02839, 10 minutes, BW

12. Starfish Anatomy, (transparency)
    AV# 2-00014

13. The Agility of Starfishes, (slides)
    AV# 5-20152

14. Marine Life
    AV# 1-02681, 11 minutes, C

15. Sponges and Coelenterates
    AV# 1-02172, 11 minutes, BW

16. Florida Shells (model)
    AV# 6-00121

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17. Mysteries of the Deep
AV# 1-31432, 28 minutes, C

18. The Sea
AV# 1-31481, 11 minutes, C

19. Actions of Lenses and Shutters
AV# 1-05421, 12 minutes, BW

20. The Basic Camera
AV# 1-11701, 15 minutes, BW

21. Elementary Optics in Photography
AV# 1-11699, 19 minutes, BW

22. Navy Photography in Science
AV# 1-31347, 18 minutes, BW

23. Sounds in the Sea
AV# 1-11178, 14 minutes, C

FILMS (Not available through A-V Center Dade County)

24. The Undersea World of Jacques Cousteau Series
Doubleday Multimedia Materials (buy or rent)

25. Outdoor Fish Cookery
Motion Picture Service, Florida Cooperative Extension Service
Editorial Department, University of Florida, Gainesville,
Florida 32601

26. Courtesy Afloat

27. Aid to Navigation

28. Legal Requirements

29. Safety Equipment

30. Coast Guard Auxiliary

31. Search and Rescue
U.S. Coast Guard Auxiliary, Division of Public Education

32. Boating Safety
Free from local Johnson motor dealer

33. Boats, Motors, and People
American Red Cross Chapter Office

34. Water Rescue
Ideal Pictures, 55 N. E. 13 Street, Miami, Florida 33132

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FILM LOOPS

Ealing Corporation, Cambridge, Mass., 1968.

1. Tidepool Life #1
2. Tidepool Life #2
3. How Animals Move Underwater
4. Introduction to the Coral Reef
5. Territorial Behavior--Fishes
6. Echinoderms and Sea Squirts

Doubleday Multimedia Materials

7. Molluska
8. Octopus
9. Sea Slugs

FILMSTRIPS

Encyclopedia Britannica, Educational Corporation, 425 North Michigan Avenue, Chicago, Illinois

1. Fishes; Animals with Backbones F.S. 596 1967
2. Maintaining Biological Specimens series #11590
3. Classification of Fish series #10530

Filmstrip of the Month, Educational Developmental Laboratories- Control Reading Series FF = 1968

4. Plants of the Sea
5. Marine Animals
6. Costeau

McIntyre Visual Publications, P. O. Box 297, North Main Street, Champlain, New York 12919

7. Freshwater Life

Scott Education, Holyoke, Mass.

8. Water Life Set JH 1370 F

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DADE COUNTY SLIDES

1.	The Sponge	AV# 5-30024
2.	Starfish Anatomy	AV# 5-30025
3.	Underwater Set 1	AV# 5-20090
	Set 2	AV# 5-20036
	Set 3	AV# 5-20058

Division of Public Education Office, U.S. Coast Guard Auxiliary

4. 35mm Slides on boating

DADE COUNTY MODELS

5.	The Fishing Industry in Florida	AV#4 6-00124
6.	The Fishing Industry in Florida; where fish are	6-00149
7.	Perch	6-00178
8.	Florida Shells Set 1	6-00121
	Set 2	6-00052
	Set 3	6-00159
	Set 4	6-00001

SUGGESTED DISCUSSION QUESTIONS

1. What hull types are most suited to local conditions and purposes?
2. What type of gear is needed for heavy weather on board vessels?
3. What knots are best suited for various purposes?
4. What are the appearance of various local navigational aids from specified locations both day and night?
5. What is the source of various Rules of the Road?
6. What traffic situations demand immediate responses and what should these responses be?
7. What are the basic legal requirements of all local boatowners?
8. What measures can be taken in the event of motor failure at sea?
9. What does one do if his underwater camera leaks?
10. How can underwater photographs be improved?
11. How can underwater sound recordings be improved?
12. How does pollution affect the aquatic communities?

13. When is the best time to fish for certain species of fish?

14. What is the bag and size limit rules for Florida fish?

15. How does weather affect fishing?

16. How do tides affect fishing and why?

17. Why are there bag and size limits and season rules for gamefish?

18. How can one select a good place to fish?

19. What fishing equipment is most likely to present corrosion problems?

20. What can be done about saltwater corrosion?

21. What types of life inhabit the freshwater areas?

22. What types of life inhabit the canals and rivers?

23. What types of life inhabit Biscayne Bay?

24. What types of life inhabit the reefs?

25. What types of life inhabit the gulfstream?

26. How can one choose the best possible bait when fishing for a certain species?

27. Why is saltwater so highly corrosive?

28. What factors determine where a certain species of fish will be found?

MATERIALS (Recommended for each class of 30 students)

		Quantity
1.	Reel oil	1 can
2.	Reel lube	1 tube
3.	Fisherman's cutters	2
4.	Rope 1/4" Sessile	90 feet
	1/4" Dacron	12 feet
	1/4" Nylon	12 feet
	1/4" Manila	12 feet
	1/4" Ski rope (polyurethane)	12 feet
	3/4" Manila	50 feet
5.	Whipping line (for above)	2 spools
6.	Saltwater aquariums with accessories	2 or 3
7.	Fiberglass boat repair kits	5
8.	Miniature Benson Anchor (Benson Anchor, Inc. 471 Polaski Street, Syracuse, New York 13204)	1
9.	1/2" Wooden dowels, 3 feet in length	3
10.	1/8" x 3' Sheet Balsa wood	1
11.	Single edge razor blades	1 package
12.	Model airplane paints--black	2 bottles
	red	2 bottles
	yellow	1 bottle
	green	1 bottle
	white	1 bottle
13.	Paint thinner	1 pint
14.	Brushes (small)	12
15.	Navigational dividers 8"	10
16.	Navigationsl parallel rule- 15"	10
17.	Compasses--army type in case (Silva Ranger)	10
18.	Mooring cleat for boat	1
19.	Mooring chock for boat	1
20.	U.S. Coast Guard approved life vest	1
21.	Buoyant cushion	1
22.	Boat vent scoops (plastic) 4"	2
23.	Venthose 4"	4 feet
24.	Flame arrestor for inboard engine	1
25.	Mock up outboard motor	1
26.	Mock up ignition system (outboard)	1
27.	3" spools of recording tape	6
28.	Vinyl electrician's tape	2 rolls
29.	Model outboard boat (scaled and detailed for teaching terms)	1

RECORDS

30. "Sounds in the Sea" available from Robert O. Borst, 755 Hwy. 17 and 92, Fern Park, Florida 32730
31. "Voices of the Deep" Education Department Hill and Knowlton, Inc., 201 East 42 Street, New York, New York

STUDY PRINTS

B.F.A. Educational Media, 2211 Michigan Avenue, Santa Montica, California.

32. Marine life of the Seashore

REFERENCES

1. Allyn, Robert. Dictionary of Fishes (in Spanish). New York: Great Outdoor Publishing Company, 1963.

2. Basic Seamanship. U.S. Coast Guard Auxiliary, 1959.

3. Bowditch, Nathaniel. American Practical Navigator. Washington, D.C.: U.S. Navy Hydrographic Office, 1966.

4. Chapman, Charles F. Small Boat Handling. New York: Motor Boating, 959 8th Avenue, 10019, 1965-

5. Rubin, Lewis D. Cloud Chart. P. O. 8615, Richmond Virginia.

6. Coast Warning Facilities Chart. Superintendent of Documents, Washington, D.C. 20402.

7. Dade County Chamber of Commerce. Water Sports Map and Guide of Greater Miami.

8. Fin. Coral Gables, Florida: Fin Publishing Co., Inc., 1971.

9. Rebikoff, Damieri. Underwater Photography. New York: American Photographic Book Publishing Co., Inc., 1965.

10. Scharff, Robert. Standard Handbook of Saltwater Fishing. New York: Thomas Y. Crowell Co., 1966.

11. Stephens, William. Southern Seashores. New York: Holiday House, 1968.

12. "Student's Ocean Science Study Kit SP-117" U.S. Naval Oceanographic Office, Washington, D.C. 20390.

13. "Tide Tables, 1971" U.S. Department of Commerce.

14. Tucker. Applied Underwater Accoustics. New York: Pergamen N., 1958.

15. "Use Common Sense Afloat" O.B.C. of America, 333 N. Michigan Ave., Chicago, Ill., 60601.

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MASTER SHEET - RECREATION AND THE SEA

Objectives	Experiments	Demonstrations	Projects	Reports	Field Trips	Speakers	Related Problems	Films	Film Loops	Slides Models and Film Strips	Discussion Questions	Materials Records and Prints	References
1		1	1,2,3	1,2,3, 15	3,5,12, 13	1	8	26,32, 33		4	1	7,8,18,19, 29	2 Chap. 1
2		6	2	13,14	5,12	1	7,9	26,32, 33		4	8	25,26	2 Chap.1&8
3		6	3	2,3,6	3,12, 13	1		26		4	1	29	2 Chap. 1
4		2				1	1	32		4		29	2 Chap. 2
5	1,2		4	2,3,6	3	1	2			4	3	4,5	2 Chap. 3
6	1,2		4	2,3,6	3	1	2			4	3	4,5	2 Chap. 3
7	4,5		5,6	5,7,8	3	1		27		4	4	9,10,11 12,13,14	2 Chap. 4
8	5,6	3,4,5	8,9, 12	9,10	3,14	1	4,5,6			4	4	15,16,17	2 Chap. 5
9	4		6,10	11,12	3	1		32,33		4	5,6		2 Chap. 6
10			10	11,12, 13	3	1		28,32		4	7	20,21,22, 23,24	2 Chap. 7
11	4	2,10	5,6	5,11, 12	3	1		1,29, 32		4	5,6,7, 8	20,21,22, 23,24	2 Chap. 8
12			11,16, 18,20, 24,26	18,22, 29	1,4,6, 8,11	5		1,6,8, 11,14	1,2,4	3	21,22, 23,24, 25	32	1,8, 10, 11
13	8	11	15,19	19,20, 21,22, 25,26, 27	4,6	4,5					13,14, 15,16, 18,26, 28		7,8,10
14	3	11,12	14,21, 22	19,20, 26,29	6,7, 10	4,5						1,2,3	7,8,10
15				19,22	6,7	4,5						1,2,3	7,8,10
16	9,10	13	23		6,7	4,5		25				3,34	7,8,10
17	11			23		4					19,20, 27	1,2,3	7,8,10
18			15,18, 20,24, 25,26	13,29	1,9, 11	5		1,2,4, 5,6,7, 8,14, 15,16, 17	1,2,4, 6,7,8, 9	1thru8	21,22, 23,24, 25	33,34	7,8,10

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MASTER SHEET - RECREATION AND THE SEA (con't)

Objectives	Experiments	Demonstrations	Projects	Reports	Field Trips	Speakers	Related Problems	Films	Film Loops	Slides Models and Film Strips	Discussion Questions	Materials Records and Prints	References
19			11		4,8,9, 10,11	2	11	1thru8, 24	1thru8	1thru8 1,2,3	10	35	1,7,9
20	7	7,8	11,12	16	8,9, 11	3	10	19,20, 21,22		3	9,10	27,28,30, 31,32	9
21	7	7,8	11,12	16	8,9, 11	3	10	19,20, 21,22		3	9,10	27,28,30, 31,32	
22	7	7,8	11,12	16	8,9, 11	3	10	19,20, 21,22		3	9,10	27,28,30, 31,32	9

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

OCEANOGRAPHY

5369.60
SCIENCE
(Experimental)

DADE COUNTY PUBLIC SCHOOLS

DIVISION OF INSTRUCTION • 1971

OCEANOGRAPHY

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Written by John J. Mayer, Jr.
for the
DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Florida
1971

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OCEANOGRAPHY

COURSE DESCRIPTION:

This course includes a discussion of the nature of the ocean floor, the nature of sea water, and the movement of sea water which includes waves, winds, currents and the general ocean circulation. Laboratory work and field trips will be a vital part of this course.

ENROLLMENT GUIDELINES:

It is recommended that the student be familiar with basic concepts of chemical terms, possibly by having completed a course in chemistry. The student should have experienced a high level of success in all previous science courses.

STATE ADOPTED TEXTS

There are no state adopted texts at present. The teacher will need to select several books from the list of references and/or ask the students to purchase paper back editions.

PERFORMANCE OBJECTIVES

The student will:

1. Given a profile diagram, differentiate by labeling at least five of the following ocean configurations: continental shelf, trench, continental rise, ridges, abyssal plains, seamounts, guyots, pedestals, and islands.

2. Describe two of the major forces affecting continental drift.

3. Discuss four points of contrast between the marine and the fresh water environment in terms of the effects their chemistries have on living systems.

4. Given sufficient data, prepare a graph showing temperature changes with an increase in depth with sufficient accuracy to indicate a thermocline.

5. Given a depth reading, calculate the pressure within ten per cent accuracy.

6. Describe two of the three ways sunlight is modified as it passes through sea water.

7. Demonstrate two of the three major differences between sound transmission in air and sound transmission in water by designing an experiment which could be used in a classroom.

8. Given a diagram of waves, label the crest, trough, height, and length with 100% accuracy.

9. Given a tide table, predict the time and height of daily tides accurately.

10. List four major factors that produce ocean currents.

11. Given an ocean current, propose reasons how the current is formed by one or more of the above major factors.

12. Diagram on a world map three of the five major ocean gyres.

13. List four of the factors producing wave generation.

COURSE OUTLINE

I. The Ocean Floor

A. The shape of the ocean floor.

B. Features of the ocean floor.

C. Continental drift theory.

II. The nature of sea water

A. Chemical
1. Dissolved salts
a) Salinity
b) Chlorinity
2. Dissolved gases

B. Physical
1. Temperature
2. Pressure
3. Light transmission
4. Sound transmission

III. The movement of sea water

A. Waves
1. Wind
2. Tidal
3. Tsunami

B. Currents
1. Wind
2. Density
a) Temperature
b) Salinity
3. Coriolus Force
4. General oceanic circulation

EXPERIMENTS

Rabinowitz, A. Oceanography, An Environmental Approach to Marine Science. Paterson, New Jersey: Oceanography Unlimited, 1970.

1. Bathometric Charts (p. 126)
2. Oxygen Determination (p. 167)
3. Carbon Dioxide Concentration (p. 168)
4. Sound Transmission (pp. 170-171)
5. Light Penetration (pp. 172-173)
6. Waves-Ripple Tank (pp. 154-156) Include seiching-saucer effect
7. Tides (pp. 139-141)
8. Major Currents (pp. 142-148)
9. Currents-Surface Circulation (pp. 149-152)

State Department of Education. The Source Book of Marine Science. Tallahassee: The Florida State Department of Education, 1968.

10. Chlorimetry (p. 43, p. 39)
11. pH Determination (p. 35)
12. Salinity Effect on Organisms (p. 133)
13. Light Penetration (p. 135)
14. Light Absorption (p. 29)
15. Light (p. 33)
16. 24 Hour Clock (p. 9)
17. Tide Tables (p. 11)
18. Currents (p. 15)

Malm, L. Chemistry An Experimental Science. (Lab Manual). San Francisco: W. H. Freeman and Company, 1963.

19. Titration (Exp. 23, p. 61)

Frantz, H. Fundamental Experiments for College Chemistry. San Francisco: W. H. Freeman and Company, 1963.

20. Freezing Point Depression (Exp. 20, p. 185)

INNOVATIVE ACTIVITIES

1. Bottom Deposits Lab. (Information may be obtained from John Banta - Dade County Teacher.)
2. Making Models of Ocean Bottom Features (teacher creativity)
3. Quantitative Determination of Dissolved Salts (Have students evaporate sea water and carefully weigh the remaining salts.)
4. Plasmolysis (Place sticks of carrots in salt water)
5. Temperature and Viscosity (Use oil at various temperatures - use a Water Bath: DO NOT HEAT IN DIRECT FLAME.)

DEMONSTRATIONS

1. Demonstrate the Coriolus Force by using a record turn table and marbles rolling across the surface of the turn table.

2. Show the proper use of the Secchi disc and water sampling bottles. A Nansen bottle might be borrowed from the University of Miami's Rosenstiel School of Marine and Atmospheric Sciences.

3. Concentrate a sample of sea water and precipitate the chlorine by adding silver nitrate to the sample.

4. Demonstrate density gradients by using various solutions of different densities. Relate this to ocean currents and density currents.

5. Determine the pH of sea water by using an electric pH meter, hydrion papers, and various indicators.

6. Select a sample of beach sand and determine the various sizes of the constituents by making a set of sieves. Use different mesh wire sieves and record what size particles pass through and which remain behind.

ALL OF THE ABOVE DEMONSTRATIONS WITH SOME VARIATIONS ARE CONTAINED IN THE REFERENCE, OCEANOGRAPHY: AN ENVIRONMENTAL APPROACH TO MARINE SCIENCE. PATERSON, NEW JERSEY: OCEANOGRAPHY UNLIMITED, 1970.

PROJECTS

1. Using plaster of paris construct a model of the ocean basin. Select an ocean that has several features, such as ridges, guyots, seamounts, and trenches.

2. Obtain old bottles and make them into drift bottles. Insert stamped postcards with the return address and a brief note to the finder of the bottle as to your project. This should be done early in the year so you will have plenty of time to hear from the finders of the bottles.

3. Collect a sample of sea water and determine the salinity, chlorinity, and oxygen content. Reference: Oceanography, An Environmental Approach to Marine Science.

4. Set up a ripple tank and construct barriers that would simulate natural barries that produce various wave patterns.

5. Show the general wind circulations on a map of the world and relate the major ocean currents to the wind patterns.

6. Grow plants under sea water and expose various plants to different colored lights. Use filters of various colors and have a control plant.

7. Analyze a sample of sea water for various pollutants. Reference: Oceanogrphy, An Environmental Approach to Marine Science. Ch. 29.

8. Study the effects of erosion on one of the beaches on Miami Beach or Crandon Park. Visit regularly for at least a month and keep a record of changes that occur. Pictures at various intervals would help keep records. Visit after storms or very high tides.

9. Concentrate a several gallon sample of sea water down to a one pint sample; boiling the sample slowly over a period of time should prove successful. Using a general qualitative analysis text, devise a method to precipitate and separate various anions and cations contained in the sample of sea water.

10. Visit an oceanographic research vessel and report to the class on the equipment and experiments that are carried on in the ship's laboratories.

REPORTS

1. Submarine Topography
2. Echo Sounding
3. Nature of the Gulf Stream
4. Tsunamis
5. Survival Under Pressure
6. Chemical Composition of Sea Water
7. H.M.S. Challenger 1873-1876
8. Lt. M. F. Maury, U.S.N.
9. Alexander Agassig
10. The Mohole Fiasco
11. James Clark Ross
12. Robert Peary
13. Richard E. Byrd
14. Jacques-Yves Cousteau
15. The Origin of the Oceans
16. Continental Drift
17. Dating Geological Samples
18. Wave Erosion
19. The Nature of Thermoclines
20. The Circulation of the Oceans
21. Values of Bottom Samples
22. Underwater Construction for High Pressure
23. Light Absorption by Water
24. Sound Transmission under Water
25. Tidal Variations around the World
26. Ocean Waves

FIELD TRIPS

1. Students should make individual or group trips to the beaches to study such things as waves, erosion of beaches, currents at high and low tide. Suggestions: South Beach on Miami Beach, Bear Cut on Key Biscayne, Cape Florida near the light house, or any area along the Florida Keys.

2. Visit the oceanographic vessels of the University of Miami's Rosenstiel School of Marine and Atmospheric Sciences.

3. Tour the facilities of the Tropical Atlantic Biological Laboratory on Virginia Key. Contact Public Relations Office.

GUEST SPEAKERS

1. Dr. Jesse White, Seaquarium veterinerian.
2. Rosenstiel School of Marine and Atmospheric Sciences. Contact Public Relations Office.
3. The National Hurricane Center, Coral Gables. Request a speaker on weather patterns, wind circulations or related subjects.
4. The Power Squadron of Miami or Hialeah may provide a speaker on navigation or related topics.

DADE COUNTY 16mm FILMS

1. Between the Tides
   AV# 1-11071, 20' C
2. Coral Wonderland
   AV# 1-30697, 30' C
3. Exploring the Ocean
   AV# 1-02069, 11' C
4. Fish, Moon, and Tides
   AV# 1-11177, 11' C
5. Life in the Ocean
   AV# 1-11043, 18' C
6. Secret of the Undersea World
   AV# 1-11141, 16' C
7. Sounds in the Sea
   AV# 1-11178, 14' C
8. Whales and Whalerman
   AV# 1-11522, 22' C
9. The Ocean of Air
   AV# 1-10999, 14' C
10. Origins of Weather
    AV# 1-10994, 13' C
11. Ocean Current
    AV# 1-13128, 17' C

FILM STRIPS

1. Glaciers-Materials of the Earth's Crust. Wards Natural Science Series, 1963.
2. Lakes and Oceans. Wards Natural Science Series, 1963.
3. Lakes and Oceans-Geomorphology. Wards Natural Science Series.
4. The Miracle of the Sea Part IX. Life, 1954.

FILM LOOPS

1. Density (Concept in Chemistry Series) Britannica, 1967.
2. Sandy Ocean Floor (Marine Biology Series) Britannica, 1967.

TRANSPARENCIES

These transparencies are available from the Dade County Media Center. Order in advance and they will be prepared and sent to the teacher.

Earth Science Masters

No. of Cells	Trans #	Title
5	G42	Evolution of a Sand Dune
5	G43	Some Types of Dunes
5	I 52	Wave Refraction
5	I 53	Seaward Growth of a Delta
5	I 54	Coastal Erosion and Deposition
5	I 55	Coral Reef Forms
5	K 58	Submarine Relief
5	L 75	Convection Circulation in the Atmosphere
4	L 78	Atmospheric Circulation in the Northern Hemisphere
1	L 80	Floor of the Atlantic
6	L 81	The Spreading Floor of the Atlantic Ocean
5	L 82	Major Currents of the Ocean
5	L 83	Deep Water Circulation of the Atlantic
6	L 84	The Distribution of Sediments in the Ocean
5	L 85	Life Zones in the Sea
5	L 95	Tides

DISCUSSION QUESTIONS

1. Explain one theory of trench formation.
2. How are coral atolls formed?
3. How would you explain the theory that guyots are sunken islands?
4. Discuss some of today's most modern instruments used in mapping the ocean floor.
5. Discuss ocean sounding from the very beginning to the present day.
6. Explain the significance of bathymetric contour data as applied to (a) national military defense, (b) the petroleum industry, (c) navigation of surface shipping, (d) oceanic cable communication.
7. What are two possibilities for the formation of continental shelves?
8. Discuss two major human disasters that have occurred in recent years that were due to massive crustal movements.
9. Where is the deepest part of all the oceans located? What is its name and how was the data obtained?
10. How are rip currents developed along beach areas?
11. How might a swimmer return to shore safely if he is caught in a rip current?
12. How do tsunamis differ from ordinary wind-driven waves?
13. List and describe four methods that are used to measure ocean currents.
14. Describe the Gulf Stream as it passes along the Florida Coast and then joins the North Atlantic Drift.
15. Relate the Coriolis effect to (a) ocean currents and (b) atmospheric currents.
16. Explain the probable cause of deep water counter currents by forming your own hypothesis.
17. Discuss the transfer of energy involved from the sun to a wave breaking on the shore.
18. Does the general appearance of the beach change with the seasons? If so, why? If not, why not?
19. Could the gain or loss of beach material be computed by comparing beach profiles from time to time?
20. Could the roundness of particles be related to the age of the particles?
21. Could a photographic light meter be used on bottled water samples? How could a comparison be made with the Secchi Disc field readings? (Did you ever candle an egg?)
22. Is there a conspicuous color change of fishes with an increase in depth? How do you account for this?
23. How deep does light penetrate into the ocean depths?
24. What techniques can be used to verify the presents of light at a given depth?
25. In which bodies of water would you expect to find the greatest degree of turbidity? The least?

REFERENCES

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4. Clemens, Elizabeth. Waves, Tides, and Currents. New York: Knopf, 1967.
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17. Russell, F. S. and Yonge, C. M. The Seas. New York: Frederick Warne and Co., Ltd., 1963.
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23. Stephens, William M. Science Beneath the Sea. New York: P. Putnam's Sons, 1966.
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28. U. S. Coast and Geodetic Survey. Manual of Current Observations. Special Publication No. 215, rev. ed., U. S. Gov't Printing Office: Washington, D. C., 1968.
29. U. S. Dept. of Commerce Environmental Science Services Administration. Coast and Geodetic Survey, East Coast N. and S. America including Greenland. U. S. Printing Office: Washington,D. C., 1968.
30. U. S. Naval Oceanography Office. Oceanography and Underwater Sound for Naval Applications. Special Pub. No. 84. U. S. Printing Office: Washington, D. C., 1965.
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RESOURCE LIST

1. Rabinowitz, A.; Sutton, T. B. and Taylor, E. M. Oceanography:An Environmental Approach To Marine Science. Paterson, New Jersey: Oceanography Unlimited Inc., 1970.
2. State Department of Education. The Source Book of Marine Sciences. Tallahassee, Florida: State Department of Education, 1968.

MASTER SHEET - OCEANOGRAPHY

Objectives	Experiments	Text References	Films	Film Loops	Reports	References	Demonstrations	Speakers	Film Strips	Field Trips
1	1, 6	Earth Science, Namowitz and Stone	1, 9	2	15, 16, 17				1	
2		Earth Science, Namowitz and Stone			1, 16	5, 11, 12 13, 19	4		1	
3	19, 2, 10 3, 11, 12	Resource List #1	1, 4, 5	1, 2	5	1, 5, 8, 9, 11, 12, 14, 16, 20, 21, 22, 31		3	1, 2, 4	1, 2
4	20	Resource List #1			19	5, 11, 12, 14, 15, 17, 23, 25, 32			4	
5		Ecology Field Biology, R. Smith			5, 22	1, 5, 11, 15, 17, 23, 25, 32				
6	5, 15, 19	Ecology Field Biology R. Smith	5		23	1, 5, 11, 12, 14, 15, 17, 22, 23, 25	2	2	4	
7		P.S.S.C. Physics Text			2, 24	1, 11, 12, 22, 23, 25, 26, 30, 32	4	3		2
8	6	Earth Science, Namowitz and Stone	11		4, 26	1, 2, 4, 5, 11, 12, 14, 25, 31, 32				1
9	16	Resource List #1	1		25	1, 3, 4, 5, 6, 11, 12, 14, 15, 17, 32			2, 3	2, 3
10	8, 9, 18	Resource List #1	11		4, 25, 26	1, 4, 5, 11, 12, 14, 15, 23, 25, 28, 32				2
11	6, 8, 9, 18	Resource List #1	10, 11		1, 25, 26	1, 5, 11, 12, 14, 15, 17, 23, 25, 32		2	2, 3	
12	8, 9, 18	Earth Science Namowitz and Stone	10, 11,		1, 20	1, 2, 4, 5, 11, 12, 14, 23, 25, 32	1			
13	6, 7	Resource List #1	9,11	1	4, 26	1, 2, 4, 15, 25, 31, 32		1,2,3		1, 2

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

MARINE ECOLOGY OF SOUTH FLORIDA

5365.63

SCIENCE
(Experimental)

DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1971

MARINE ECOLOGY OF SOUTH FLORIDA

5365.63

SCIENCE

(Experimental)

Written by J. Banta and R. Climer
for the
DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Florida
1971

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COURSE DESCRIPTION

This course in marine ecology is intended to extend the students' awareness of ecological concepts to the marine environment. Building upon skills and knowledge acquired in previous science courses, the students will be able to identify and become actively involved in solutions to ecological problems. While the major emphasis should be on academic aspects such as energy relationships, biomass distribution and specific marine ecosystems - the social, political and economic forces involved should lead the student to interdisciplinary activities.

ENROLLMENT GUIDELINES

Indicators for a student's success are the satisfactory completion of introductory courses in both ecology and marine science.

STATE ADOPTED TEXTS

There are no state adopted texts for this course. A combination of several of the references could be used as student texts. These are references #10 and #25. The teacher will find reference #16 to be an excellent source book.

PERFORMANCE OBJECTIVES

1. Given a marine ecological system of energy exchange, the student will deduce the productivity of each level of biomass production.

2. Given the constant rates of energy transformation into biomass of a specific marine ecosystem, the student will predict their ecological efficiency.

3. Given a marine environment with the numbers of individuals located in each unit of space, the student will

    a. Identify variables related to the distribution of individual species.

    b. Propose a plan of distribution and the related causative environmental factors.

4. Given a group of individual marine open sea organisms and the data of their existence and changes over a period of time, the student will formulate hypotheses of the open sea organisms' evolutionary pattern of change in time.

5. Given a diagram the student will identify the major oceanic divisions and subdivisions.

6. Given a list of animals the student will describe the communities in which they are most apt to be found.

7. The student will identify examples of various kinds of symbiosis.

8. The student will devise a method to demonstrate an example of a behavior of a marine organism in a marine environment.

9. The student will discuss critically the local problems related to marine pollution.

10. The student will propose causes with justification for the great variety of life on a coral reef.

COURSE OUTLINE

I. Introduction to the Ecology of Marine Systems

A. Trophic levels of energy organization in marine ecosystems

1. Solar radiation
2. Producers
3. First order consumers
4. Second order consumers
5. Reducers

B. Distribution concepts

1. Zonations or distributions of organisms in space
2. Distribution of marine organisms in time -- evolution

C. Concepts of related sciences in marine ecology

1. Marine biogeochemistry
2. Ecosphere and biosphere studies
3. Meteorology
4. Climatology
5. Topography

II. Marine Communities of Interaction

A. Epipelagic communities of the open sea

1. Diatomaceous communities
2. Plankton communities
3. Necton communities

B. Abyssal communities of the open sea

1. Invertebrate
2. Vertebrate
3. Variety and adaptation to life under pressure

C. Hadel Zone communities from continental shelf to shore

1. Coral reef communities
2. Thalassia grassbed communities
3. Mudflat and sandbar communities
4. Intertidal zone communities
5. Mangrove estuaries
6. Piling wharf fouling communities

D. Interacting marine communities

1. Behavioral interaction within species

a. Social behaviors or social order
b. Leadership behaviors
c. Arena behavior
d. Migration behavior
e. Mating behavior

2. Behavioral interactions between species

a. Mutualism
b. Predator-prey
c. Symbiosis
d. Parasitism
e. Epiparasitism
f. Territoriality

III. Management of Natural Marine Resources

A. Fisheries resource management

1. Distributions of fishing grounds in South Florida

a. Methods of management
b. Productivities and yields

B. Marine park resources management

C. Political and economic problems of marine resource management

D. Marine pollution

1. Sewage disposal pollution
2. Mineral nutrient pollution
3. Detergents
4. Thermal pollution

EXPERIMENTS

Florida State Department of Education. The Source Book of Marine Sciences. Tallahassee, Florida: State Department of Education, 1968.

1. Salt-water Aquaria of the Laboratory-classroom (p. 1)
2. Turbidity (p. 29)
3. Determination of Suspended Solids in Water (p. 33)
4. pH Determination of Sea Water (p. 35)
5. Microscopic Forms in the Sand (p. 47)
6. Agar Digesters (p. 53)
7. Plankton (p. 63)
8. The Living World Within a Sponge (p. 73)
9. A Statistical Analysis of a Fiddler Crab Colony (p. 103)
10. Determining the Age of Fish by Counting Scale Rings (p. 127)
11. Evidence of the Feeding Habits of Fishes (p. 131)
12. Determining Salinity Tolerances of Local Organisms (p. 133)
13. Determination of Population Size by the Lincoln Index Method (p. 137)
14. Statistical Methods (p. 141)
15. Analysis of Floating Seaweed Populations (p. 145)

Rabinowitz, Sutton & Taylor. Oceanography: An Environmental Approach to Marine Science. Paterson, New Jersey: Oceanography Unlimited Inc., 1970.

16. An Overview of the Ocean Environment (p. 8)
17. Salt Water Aquaria for the Laboratory and Classroom (p. 12)
18. Collecting and Preserving Marine Organisms (p. 17)
19. An Overview of the Animal and Plant Kingdoms (p. 24)
20. Marine Bacteriology (p. 37)
21. Plankton (p. 40)
22. Basic Marine Ecology (p. 113)
23. Water Pollution Detection and Analysis (p. 181)

Curriculum Bulletin 8B-2. The Ecology and Natural History of Florida. Miami, Florida: Dade County Public Schools, 1970.

24. Techniques for Measuring Turbidity (p. 112)
25. Stomach Analysis (p. 134)
26. Techniques for Marine Bacteria Studies (p. 158)
27. Plankton (p. 176)
28. Coral Growth (p. 186)
29. Techniques for Determination of Fish Age (p. 249)
30. Microscopic Forms in the Sand (p. 318)
31. Salt-water Aquaria for the Laboratory-Classroom (p. 399)

PROJECTS

1. The study of marine fouling
2. Animals and plants of the mangrove community
3. Barnacle attachment preferences
4. The effects of added nutriments on a marine community
5. The effects of salinity on the growth of E. coli
6. Produce film loops showing local examples of symbiosis
7. Determine the role the color of the sand has in the coloration of Uca
8. Sensitivity in starfish to various wave lengths of light
9. Prepare permanent slides showing the larval stages of various crustaceans
10. Population studies related to pollution
11. Is nitrate or phosphate ion concentration the limiting factor in the growth of algae?
12. The effects of reducing the amount of sunlight on sections of Thalassia beds

REPORTS

1. Bioluminescence
2. Symbiosis in marine species
3. Mercury pollution in marine organisms
4. Productivity in marine communities
5. Food chains characteristic of marine ecosystems
6. Methods for increasing sea productivity
7. Aquaculture methods and mariculture methods
8. Thermal pollution in marine communities
9. Organism interaction in marine fouling communities
10. Raising Tiliapa
11. Effects of oil pollution on marine environments
12. The effects of non-biodegradable materials on marine environments
13. Oceanic law
14. Sea landfill problems and thermal studies of high water line
15. Energetics of marine productivities
16. New and unusual mechanical devices for marine exploration
17. Why is the sea salty?
18. Deep sea scattering layers
19. Benthic organisms and methods of adaptation to pressure
20. Rare and endangered marine species
21. Salt water intrusion
22. Light transference in marine ecosystems
23. Ancient temperatures
24. Marine paleoecology
25. Marine algae antibictics
26. Marine bacteriology
27. Marine resources of the United States
28. The theory of continental drift
29. Estuarine productivities
30. The types of coral and world distribution of species
31. The types of mollusks and their world distribution

FIELD TRIPS

1. Bear Cut
   Key Biscayne

2. Crandon Park
   Key Biscayne

3. Card Sound
   Card Sound Causeway (new bridge)

4. Tropical Atlantic Biological Laboratories
   75 Virginia Beach Drive
   Virginia Key

5. Matheson Hammock Beach
   Old Cutler Road
   Coral Gables

6. University of Miami
   Rosenstiel School of Marine and Atmospheric Sciences
   Virginia Key

7. Florida Power and Light Co.
   Turkey Point Mariculture project

SPEAKERS

1. Mr. Leonard Pardue, American Meteorological Society
   U. S. Weather Bureau, National Hurricane Research Laboratory
   P. O. Box 8265, University of Miami Branch, Coral Gables, Florida

2. Mr. Norris McElya
   South Florida Shell Club
   Box 4794, Miami, Florida

3. Mrs. Flora O'Brien
   Tropical Audubon Society
   4440 West Flagler Street, Miami, Florida

4. Mr. Cliff Head
   Central and South Florida Flood Control District
   P. O. Box 1671, West Palm Beach, Florida 33402

5. Mr. Peter Baljet
   Dade County Air and Water Pollution Control
   864 N.W. 23 Street, Miami, Florida

6. Environmental Education Committee of the University of Miami
   P. O. Box 8236, University of Miami Branch, Coral Gables, Florida

7. Environmental Science Services Administration (ESSA)
   901 South Miami Avenue, Miami, Florida

8. Mrs. Ann Weeks
   Tropical Atlantic Biological Laboratories (TABL)
   75 Virginia Beach Drive, Key Biscayne, Florida

9. Water Resources Division, U. S. Geological Survey
   Box 348, Coconut Grove Station, Miami, Florida

DADE COUNTY 16 mm. FILMS

	Title	AV#	Length	C or BW
1.	Animal Life at Low Tide	1-02696	11'	C
2.	Animals That Live in the Surf	1-02699	11'	C
3.	Aquarium Wonderland	1-02402	10'	C
4.	Beach and Sea Animals	1-02664	11'	BW
5.	Biography of a Fish	1-02827	10'	BW
6.	Birth of a Florida Key	1-12252	18'	C
7.	Challenge of the Ocean	1-30366	29'	C
8.	Fish, Moon, and Tides: The Grunion Story	1-11177	15'	C
9.	Fish Out of Water	1-02835	11'	BW
10.	From Water to Land	1-30548	28'	C
11.	Life in an Aquarium	1-02671	10'	BW
12.	Marine Animals of the Open Coast	1-11075	22'	C
13.	Sea Shell Animals	1-02682	10'	C
14.	Secrets of the Underwater World	1-11144	16'	C
15.	Sponges and Coelenterates	1-02172	11'	BW
16.	Algae	1-11117	16'	C
17.	Beach, The; A River of Sand	1-30354	20'	C
18.	What Makes Clouds	1-11002	19'	C
19.	Waves On Water	1-10987	16'	C
20.	What Makes the Wind Blow	1-10997	16'	C
21.	Blessing from the Sea	1-11022	20'	C
22.	Sea Turtles of Florida	1-11191	14'	C
23.	The Story of the Sponge	1-11527	11'	BW
24.	The Restless Sea Part 1	1-30369	30'	C
25.	The Restless Sea Part 2	1-30371	30'	C
26.	Ocean Tides, Bay of Fundy	1-10972	14'	BW
27.	Science of the Sea	1-10986	19'	C
28.	What's Under the Sea	1-10989	14'	C
29.	Japan Harvests the Sea	1-30936	29'	C
30.	Freighter at Sea	1-10426	17'	C
31.	Arctic Codfishing	1-11941	17'	C
32.	Between the Tides	1-11071	20'	C
33.	Sounds in the Sea	1-11178	14'	C
34.	Some Creatures of the Barrier Reef	1-02686	10'	C
35.	Tigers of the Sea	1-03928	10'	BW
36.	Shells of the Sea	1-02691	11'	C
37.	Shellfishing	1-03930	11'	BW
38.	Seal Island	1-30689	27'	C
39.	The Mollusks	1-11149	14'	BW
40.	Gulf of Mexico Invertebrates	1-02704	15'	C
41.	Marine Animals of the Open Coast	1-11075	22'	C
42.	The Great Polar Whale	1-05093	10'	C

Films Available from Rosensteil Institute of Marine Sciences (free of charge)

43.	Minerals from the Sea	20'	C
44.	The Chain of Life in the Sea	11'	C
45.	Invisible Sea Food	10'	C
46.	Marine Borers	11'	C
47.	The Management of Fisheries	20'	C
48.	The Shrimp	10'	C

Films Available from Modern Talking Pictures, 714 Spring Street, N.W., Atlanta, Georgia (Available for return postage)

49.	The Big Deep	#1957	20'	C
50.	The Gifts	#3905	20'	C
51.	A Grain of Salt	#3232	20'	C

FILM LOOPS

International Communication Films

1. #5401 The Fur Seal
2. #5404 Marine Iguana of the Galapagos Islands
3. #5358 Walrus Colony
4. #5409 Birds of the Galapagos Islands
5. #5453 Survival on the Coral Reef
6. #5457 Crabs
7. #5458 Hermit Crabs
8. #1110 Tidepool Life - Part 1
9. #1111 Tidepool Life - Part 2
10. #5465 Bottlenose Dolphin
11. #5456 Sea Horse
12. #5460 Sea Slugs
13. #5455 Octopus
14. #5461 Manta and Sting Rays
15. #5407 Pelicans
16. #5454 Plankton Eaters
17. #5466 Grunion Fertilization and Reproduction

TRANSPARENCIES

1. Oceanography Unlimited

   a. Ocean Transparencies I
   b. Ocean Transparencies II

2. Dade County Board of Public Instruction
   Earth Science Oceanography Set 1 2-30150

FILMSTRIPS

Life Filmstrips, Time and Life Bldg., Rockefeller Center, New York, New York 10020

1. The World We Live In Series

   Part II Miracle of the Sea
   Part VII Creatures of the Sea
   Part VIII Coral Reef

2. New Portrait of Our Plant Series

   Part III Might Currents of the Sea
   Part IV Landscapes of the Sea

SLIDES

1. Dade County Board of Public Instruction

   Underwater Set 1 5-20090
   Underwater Set 2 5-20036
   Underwater Set 3 5-20058

2. World Color Inc., Route 1, Ormond Beach, Florida

   Man in the Sea, slides and teachers manual ($19.95)

SUGGESTED DISCUSSION QUESTIONS

1. How is energy related to marine life?
2. How is energy stored in marine life?
3. How does such energy flow from one form of marine life to another?
4. Is there some system of energy flow and storage in each marine community? Can you describe one?
5. Where does the energy originate?
6. How is it changed in form when it enters a living marine biological living organism?
7. Why does the energy have to be changed in form in order to enter a biological organism?
8. Is energy flow constant?
9. Is energy transformation from one level of the community to another quantitatively predictable?
10. Is energy transformation from one level of life to another efficient? How efficient?
11. Are energy losses predictable? How?
12. How is energy loss related to ecological efficiency of a marine organism?
13. In a marine environment the presence or absence of an organism is mainly a question of what?
14. Why do different marine organisms live in different habitats?
15. Why do oysters live mainly in brackish water habitats?
16. Why do sea horses live mainly in grassbeds and seaweed?
17. Why are there more of one organism (density of population) in one area than another?
18. What are some major factors that cause the zonations and distributions of marine species?
19. Why do some marine organisms change physical and behavioral characteristics over a period of time and several generations?
20. Why do some marine organisms not change over periods of time?
21. What are some examples of marine organisms that have not changed very much over thousands of years?
22. Marine organisms which change physical and behavioral character over a period of time tend to change slowly but show a trend or sequence of changes which indicate direction of change. Can you hypothesize a trend or sequence of change for the following:

    a. Jellyfish
    b. Seahorse
    c. Sharks
    d. Scallops
    e. Sargassum Fish
    f. Mackerel

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New York: Pergamon Press, 1963.

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New York: Frederick Warne and Co., 1963.

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New York: John Wiley & Sons, 1962.

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Pittsburgh, Pa.: Carnegie Institute, 1928.

Scientific American Marine Science Reprints

#124, Shaw; The Schooling of Fishes
#127, Gilbert; The Behavior of Sharks
#141, McElroy; Biological Luminescence
#860, Kort; The Antarctic Ocean
#864, Murphy; The Oceanic Life of the Antarctic
#866, Dietz; The Seas Deep Scattering Layers
#803, Kuenen; Sand
#805, Fairbridge; The Changing Level of the Sea
#807, Heezen; The Origin of Submarine Canyons
#808, Stetson; The Continental Shelf
#813, Mink; Circulation of the Oceans
#814, Fisher; The Trenches of the Atlantic
#815, Emeliani; Ancient Temperatures
#816, Kay; The Origin of Continents
#830, Bailey; The Voyage of the Challenger
#831, Millot; The Coelacanth
#845, Bascom; Beaches
#853, Pequegnot; Whales, Plankton and Man
#854, Bjorn; Continental Drift and Evolution
#855, Ewing; Seismic Shooting at Sea
#856, Isaacs; The Nature of Oceanic Life
#857, Menard; The Deep Ocean Floor

MASTER SHEET - MARINE ECOLOGY OF SOUTH FLORIDA

Objective	Experiments	Student Text	Supplementary Text	Films	Film Loops	Trans-parencies	Film Strips	Speakers	Reports
1	13, 16	#10 Chap. 12-15	853, 864, 866, 16, 17	1, 2, 12, 16, 21, 44, 35			1	8	4, 5, 6, 7, 22, 29
2	7, 21, 27	#10 Chap. 12-14	16, 17, 26	4, 5, 22, 28, 32, 40, 41, 45	5, 8, 9, 16	1		2, 4	4, 5, 6, 7, 22, 29
3	5, 22, 30	#10 Chap. 17-19	866, 805, 854, 16	13, 14, 34, 42	1, 2, 3, 4, 5, 8	1		1, 6, 7	30, 31
4	7, 12, 21, 27	#10 Chap. 17-19	815, 831, 16, 17	10, 36, 39, 46	2, 5, 7, 17	1		7, 8	23
5	16	#10 pp.177-188	807, 808, 813, 814, 816, 854	29, 25, 26, 27, 28		2	4, 5	1, 9	28
6	8, 13, 14, 15, 28	#25 Chap. 1-9	16, 26	1, 2, 4, 12, 13, 14	6, 7, 10, 11, 13, 15	2	2	3, 7	
7	1, 8, 15, 17, 20, 26, 31	#25	14, 22	15, 23, 34, 49	5, 6			8	2
8	1, 16, 17, 31	#25 various	124, 127, 12, 14	35, 39, 8, 42	77, 10, 13			8	
9	2, 3, 4, 12, 14, 23, 24		2, 16, 21	46, 47				5, 6, 7	3, 8, 11 12
10	10, 11, 18, 25, 28, 29	#10 various #25 Chap. 9	10, 14, 16, 22	34	5, 6, 7,		3		30

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

INVERTEBRATE MARINE BIOLOGY

5367.41

SCIENCE

(Experimental)

DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1971

INVERTEBRATE MARINE BIOLOGY

5367.41

SCIENCE

(Experimental)

Written by J. Banta
for the
DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Florida
1971

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INVERTEBRATE MARINE BIOLOGY

COURSE DESCRIPTION

Utilizing the wealth and diversity of local marine fauna the course should provide the student with an understanding of evolutionary processes. The evolving complexities of the various systems makes an excellent uniting theme. The student will also develop a working vocabulary of generic names and an awareness of the natural history of many of the marine invertebrates.

ENROLLMENT GUIDELINES

Indications of a student's success would be the satisfactory completion of study in general biology which dealt with taxonomy, morphology and physiology.

STATE ADOPTED TEXTS

There is no state adopted text for this course. For student use, references #22 and #23 are fine for identification and natural history. For a more detailed reference #2, #7 and #12 will answer most questions.

PERFORMANCE OBJECTIVES

1. Given a number of specimens, the student will classify them according to taxonomic principles.

2. Given a hypothetical animal, the student will predict its taxonomic relationships.

3. The student will compare the feeding and reproductive habits of sessile animals to free living animals.

4. The student will propose reasons and defend them for the absence of insects from the marine environment.

5. Given a list of animals, the student will describe their economic importance to man.

6. The student will recognize the larval and mature stages of animals from each major phylum which are planktonic.

7. The student will illustrate the life cycles of animals from several of the major phyla.

8. Given a system, such as the digestive system, the student will discuss critically the evolutionary development of the system.

9. The student will distinguish between primitive and more advanced morphological structures.

10. The student will identify, using generic names, examples from the phyla studied.

COURSE OUTLINE

I. Introduction and brief review of taxonomy

A. History
B. Definition and correct usage of terms
C. Overview of the various phyla *

II. Protozoa

A. Mastigophora
1. Dinoflagellida, Gymnodinium, red tide; Noctiluca, phosphorescence
2. Chrysomonadida; the cocolithphores as ooze formers
B. Sarcodina
1. Radiolarida, radiolarian ooze
2. Foraminiferida, foram ooze (relate ooze to past climates)
C. Other classes which are of minor importance to marine science

III. Porifera

A. Classification
1. Calcarea
2. Hexactinellida
3. Demospongiae
B. Morphology
1. Ascon
2. Sycon
3. Leucon
C. Natural history, economic importance and miscellaneous

IV. Coelenterata

A. Hydrozoa
1. Hydroida (Sertularia)
2. Milleporina (Millepora, fire coral)
3. Siphonophora (Physalia, Velella, Porpita)
B. Scyphozoa (Aurellia, Cyanea, Cassiopeia)
C. Anthozoa
1. Alcyonaria (Alcyonium and various gorgonids)
2. Zoantharia
a. Actiniaria; the anemones (Condylactus)
b. Madreporaria; the stone corals (Meandrina, Acropora, etc.)

V. Ctenophora; the comb jellies

---

*Recent revisions in classification should be considered.

VI. Assorted phyla which are of minor importance except for the evolutionary trends they show or the way they contribute to our marine environment. These could include Platyhelminthes, Nemathelminthes, Mesozoa, Acanthocephala, Nemertina, Entoprocta, Ectoprocta, Brachiopoda, Aschelminthes, Rotifera, Bryozoa, Chaetognatha (Sagitta), Sipunculida, Phoronida and others.

VII. Annelida

- A. Polychaeta
  - 1. Errantia (Hesione, Nereis)
  - 2. Sedentaria (Arenicola, Chaetoptarus, the Sabellidae, Serpulidae and Terebellidae)
- B. The trochozoon theory showing relationships between the Annelida, Nemertina and Mollusca

VIII. Mollusca

- A. Amphineura, the chitons (Acanthopleura, Ishnochiton)
- B. Scaphopoda, the tusk shells (Dentalium)
- C. Pelecypoda, the various bivalves
- D. Gastropoda
  - 1. Prosobranchiata (Littorina, Busycon, limpets, etc.)
  - 2. Opisthobranchiata; nudibranchs, pteropods, sea hares
  - 3. Pulmonata
- E. Cephalopoda (Loligo, Spirula, Nautilus, etc.)

IX. Arthropoda

- A. Classes of little marine importance such as Onychophora, Myriapoda, Trilobita, Insecta (Halobates), Arachnoidea (Limulus)
- B. Crustacea
  - 1. Brachiopoda; Artemia
  - 2. Copepoda
  - 3. Cirripedia; Balanus, Tetraclita, Lepas, Sacculina, etc.
  - 4. Malacostraca
    - a. Isopoda; Limmoria
    - b. Amphipoda; Orchestia
    - c. Stonatopoda; Squilla, Gonadactulus, etc.
    - d. Euphausiacea; Krill
    - e. Decapoda; Uca, Pagurus, Callinectes, etc.

X. Echinodermata

- A. Crinoidea, the sea lilies
- B. Asteroidea; Echinaster, Oreaster, etc.
- C. Ophiuroidea, the serpent stars; Ophiocoma, Ophiderma, etc.
- D. Holothurioidea, the sea cucumbers
- E. Echinoidea; Clypeaster, Echinometra, Lytechinus, etc.

It is expected that the teachers will include in the above outline the natural history, economic importance, life cycles of the animals which they consider to be important or interesting.

EXPERIMENTS

Climer. The Ecology and Natural History of Florida.
Miami: Dade County School Board, 1970.

1. An Analysis of Spicules from South Florida Sponges (p. 185)
2. Coral Growths (pp. 186-188)
3. An Anatomical Study of a Scyphozoan Jellyfish (pp. 191-193)
4. An Anatomical Study of a Common Ctenophore (pp. 194-196)
5. Study of the Florida Blue Crab (pp. 222-228)
6. A Study of the Horseshoe Crab (pp. 239-241)
7. Barnacles; Habits and Life Histories (pp. 242-243)

Gregory. Biological Science for High School, Laboratory Manual.
Boston: Ginn and Co., 1965.

8. Protozoans (p. 103)
9. Sponges and Coelenterates (p. 111)
10. Flat, Round and Segmented Worms (p. 119)
11. Echinoderms and Mollusks (p. 127)
12. Centipedes, Millipedes and Crustaceans (p. 133)

Korn and Korn. Investigations into Biology.
New York: John Wiley and Sons, Inc., 1965.

13. Protozoa and Diploblastic Organisms (p. 239)
14. Triploblastic Organisms (p. 255)
15. Enterocoelomates, Phylum Echinodermata (p. 276)

Rabinowitz, Sutton and Taylor. Oceanography: An Environmental Approach to Marine Science. Paterson, New Jersey: Oceanography Unlimited Inc., 1970.

16. Plankton (p. 40)
17. Porifera (p. 57)
18. Cnidaria (p. 61)
19. Platyhelminthes (p. 65)
20. Aschelminthes (p. 69)
21. Annelida (p. 73)
22. Mollusca (p. 77)
23. Arthropoda (p. 82)
24. Echinodermata (p. 87)

BSCS Green Version. High School Biology; Student's Manual.
Chicago: Rand McNally and Co., 1963.

25. Exploring Marine Communities (pp. 176-181)

State Department of Education. The Source Book of Marine Sciences.
Tallahassee, Florida: State Department of Education, 1968.

26. Salt-water Aquaria for the Laboratory-Classroom (p. 1)
27. Microscopic Forms in the Sand (p. 47)
28. Bioluminescence (p. 55)

29. The Taxonomy of Marine Animals (p. 57)
30. Plankton (p. 63)
31. Sponge Spiculation (p. 75)
32. Stinging Cells - Phylum Cnidaria (Coelenterates) (p. 77)
33. The Pelecypod Gill (p. 79)
34. Horseshoe Crab (p. 81)
35. The Class Crustacea (p. 85)
36. Barnacles (p. 91)
37. The Florida Blue Crab (p. 95)
38. Shrimp (p. 99)
39. The Florida Spiny Lobster (p. 105)
40. Sea Urchin Fertilization and Development (p. 109)

PROJECTS

1. Make a collection showing the modifications in crustacean legs.
2. A comparison of nematocysts within the hydrozoa.
3. Establish a school museum of as many classes of invertebrates as possible.
4. Make models of the evolutionary sequence of a system.
5. Study the micro-fauna of a sand beach.
6. Study the effects of polyethylene oxide on the rate of movement of echinoderms.
7. Tides and the feeding behavior of Acanthoplura.
8. Color perception in the asteroidea.
9. A series of slides and preserved specimens depicting an animal's life cycle.
10. A series of slides showing the various types of sponge spicules.
11. Factors affecting regeneration in nemertine worms.
12. Grow various invertebrates in the classroom.
13. Examine the stomach contents of certain animals to determine their feeding habits.
14. Make some collecting gear to study the life which is found in the mud flats.
15. Determine how long certain vital stains are retained in the bodies of anemones.

REPORTS

1. Drugs from the sea.
2. Sessile animals and reproduction.
3. Zoochlorellae and coral.
4. What's in a name? A translation of some common Latin names.
5. Phylogeny.
6. Any of the various minor phyla.
7. The evolution of respiratory mechanisms.
8. The natural history of a specific animal.
9. Shell and pearl production in the mollusca.
10. Some "rare" animals.
11. Animal myths.
12. Eating invertebrates for survival.
13. Biological luminescence.
14. Adaptations for planktonic living.
15. The building of a reef.
16. The evolution of copepods.
17. Defense mechanisms found in the mollusca.
18. The commercial value of various invertebrates.
19. Invertebrates dangerous to man.
20. A history of shell collecting.

FIELD TRIPS

1. Tropical Atlantic Biological Laboratories
   75 Virginia Beach Drive
   Virginia Key

2. Museum of Science-Planetarium
   3280 South Miami Avenue

3. Seaquarium
   Rickenbacker Causeway

4. University of Miami
   Rosenstiel School of Marine and Atmospheric Sciences
   Virginia Key

For collecting field trips the following locations are productive. Collecting permits are needed and there is a strong possibility that any collecting at stations #5, #6, #7 will be prohibited in the near future so it might be wise to observe and not collect at these locations.

5. Bear Cut
   Key Biscayne

6. Crandon Park
   Key Biscayne

7. Matheson Hammock
   Old Cutler Road

8. Card Sound
   Card Sound Causeway

9. Mud flats west of the Seaquarium
   Virginia Key

10. Lake Surprise
    U.S. #1 Causeway to Key Largo

SPEAKERS

1. Marine Council of Greater Miami
   615 S.W. 2nd Avenue

2. South Florida Shell Club
   Box 4794, Miami

3. Seaquarium
   Rickenbacker Causeway

4. Tropical Aquarium Society
   c/o Museum of Science-Planetarium
   3280 South Miami Avenue

5. University of Miami
   Rosenstiel School of Marine and Atmospheric Sciences
   Virginia Key

6. Tropical Atlantic Biological Laboratories
   75 Virginia Beach Drive
   Virginia Key

DADE COUNTY 16 mm. FILMS

1. The Amoeba
   AV#1-02717, 10', BW

2. Beach and Sea Animals
   AV#1-02664, 11', BW

3. Between the Tides
   AV#1-11071, 20', C

4. Coral Wonderland
   AV#1-30697, 30', C

5. Gulf of Mexico Invertebrates
   AV#1-02704, 15', C

6. The Invertebrates
   AV#1-11145, 14', BW

7. Marine Animals of the Open Coast
   AV#1-11075, 22', C

8. Marvels in Miniature
   AV#1-11143, 15', C

9. Microscopic Wonders in Water
   AV#1-02677, 10', C

10. The Mollusks
    AV#1-11149, 14', BW

11. Paramecium
    AV#1-02724, 10', BW

12. Protozoa
    AV#1-02171, 11', BW

13. Reproduction in the Sea Urchin
    AV#1-11055, 13', C

14. Sea Shell Animals
    AV#1-02682, 10', C

15. Sea Zoo
    AV#1-02707, 10', BW

16. Shellfishing
    AV#1-03930, 11', BW

17. Shells of the Sea
AV#1-02691, 11', C

18. Some Creatures of the Barrier Reef
AV#1-02686, 10', C

19. Sponges and Coelenterates
AV#1-02172, 11', BW

20. Water and Life
AV#1-11054, 15', C

21. World of Little Things
AV#1-11146, 15', C

FILM LOOPS

Encyclopedia Britania, Marine Biology Series

1. Barnacle
2. Basket Star
3. Feather Star
4. Marine Clam
5. Marine Snail
6. Relatives of the Sea Star
7. Sand Dollar
8. Sea Anemone
9. Sea Cucumber
10. Sea Urchin
11. Serpent Star
12. Scallop
13. Squid
14. Tube Worms

International Communication Films

15. Crabs #5457
16. Hermit Crabs #5458
17. Tidepool Life (parts 1 & 2) #1110 & #1111
18. Sea Slugs #5460
19. Octopus #5455

DADE COUNTY TRANSPARENCIES

1.	Protozoan	AV#2-00011	BW
2.	Starfish Anatomy	AV#2-00014	BW

DADE COUNTY SLIDES

1.	The Agility of Starfishes	AV#5-20152	C
2.	Animal Kingdom	AV#5-20105	C
3.	Animals and Their Structure	AV#5-00012	C
4.	The Clam	AV#5-30002	C
5.	The Coelenterates	AV#5-30003	C
6.	The Crayfish	AV#5-30004	C
7.	Fossil Invertebrates	AV#5-20077	C
8.	The Protozoans	AV#5-30021	C
9.	The Sponge	AV#5-30024	C
10.	Starfish Anatomy	AV#5-30025	C

FILM STRIPS

1. Life Film Strip The World We Live In, Part VII
   Creatures of the Sea

2. Life Film Strip, The World We Live In, Part VIII
   Coral Reef

SUGGESTED DISCUSSION QUESTIONS

1. Hypothesize coral reef distribution if all of the oceanic currents were reversed.

2. If porifera represent such a primitive body plan why are sponges so ubiquitous?

3. If radioactive calcium ions in the ocean were increased one million times discuss the three types of animals you feel would show the first effects.

4. What are the advantages of metagenesis as exemplified by some of the coelenterata?

5. Discuss how past climatic changes are indicated by the distribution of various oceanic oozes.

6. As body mass increases, waste removal becomes more of a problem. Use examples to illustrate the evolutionary solution to this problem.

7. Contrast a typical polychaeta to the onychophora.

8. Discuss the natural forces which seem to lead to the development of sessile life forms. Then contrast these to the forces which tend to favor motility.

9. What changes were necessary in the life cycle of crustaceans as they migrated into fresh water habitats? What has restricted their further proliferation, in terms of species, in fresh water?

10. Why do larger numbers of "primitive" life forms seem to be more common in oceanic depths?

11. Why has the sea produced so few drugs for mankind when it contains so many more plants and animals than the land?

12. Why does fresh water lack the diversity of planktonic forms found in the marine environment?

13. Suggest reasons for the range of adaptive features found in the five major classes of the mollusca.

14. Why do reefs and tropical rainforests have far more species, but not necessarily more life, than temperate regions?

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Objectives	Laboratory Experiments	Student Text	Supplementary References	Films	Film Loops	Film Strips	Transparencies	Slides
1	29	22,23	2, 7, 9	6	17	1	1	2,3
2	13, 14, 15, 17, 18, 19, 20 21, 22, 23, 24	2, 7	2, 7, 9, 17	6		3		
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4	12, 14, 23, 35	2, 7	2, 3, 7, 9, 12	20				6
5	2, 5, 7, 11, 12, 22, 23, 35, 36, 37, 38, 39	2, 7	8, 12, 20	4, 16				
6	16, 17	2, 7	4, 6, 8, 20	1, 5, 19, 13	1, 2, 4, 10		1	
7	11, 21, 22, 23, 24, 40	2, 7	2, 7, 9, 12	5, 6				5
8	13, 14, 15	2, 7	2, 7, 9	6, 20			2	7, 10
9	13, 14, 15, 29	2, 7	2, 7, 9	7, 4			2	10
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